1. Subbasin Assessment – Watershed Characterization

The federal Clean Water Act (CWA) requires that states and tribes restore and maintain the chemical, physical, and biological integrity of the nation's waters. States and tribes, pursuant to Section 303 of the CWA are to adopt water quality standards necessary to protect fish, shellfish, and wildlife while providing for recreation in and on the waters whenever possible. Section 303(d) of the CWA establishes requirements for states and tribes to identify and prioritize water bodies that are water quality limited (i.e., water bodies that do not meet water quality standards). States and tribes must periodically publish a priority list of impaired waters, currently every two years. For waters identified on this list, states and tribes must develop a total maximum daily load (TMDL) for the pollutants, set at a level to achieve water quality standards. This document addresses the water bodies in the Little Wood River Subbasin that have been placed on what is known as the "§303(d) list."

The overall purpose of this subbasin assessment and TMDL is to characterize and document pollutant loads within the Little Wood River Subbasin. The first portion of this document, the subbasin assessment, is partitioned into four major sections: watershed characterization, water quality concerns and status, pollutant source inventory, and a summary of past and present pollution control efforts (Sections 1 – 4). This information will then be used to develop a TMDL for each pollutant of concern for the Little Wood River Subbasin (Section 5).

1.1 Introduction

In 1972, Congress passed the Federal Water Pollution Control Act, more commonly called the Clean Water Act. The goal of this act was to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters" (Water Pollution Control Federation 1987). The act and the programs it has generated have changed over the years as experience and perceptions of water quality have changed. The CWA has been amended 15 times, most significantly in 1977, 1981, and 1987. One of the goals of the 1977 amendment was protecting and managing waters to insure "swimmable and fishable" conditions. This goal, along with a 1972 goal to restore and maintain chemical, physical, and biological integrity, relates water quality with more than just chemistry.

Background

The federal government, through the U.S. Environmental Protection Agency (EPA), assumed the dominant role in defining and directing water pollution control programs across the country. The Department of Environmental Quality (DEQ) implements the CWA in Idaho, while the EPA oversees Idaho and certifies the fulfillment of CWA requirements and responsibilities.

Section 303 of the CWA requires DEQ to adopt, with EPA approval, water quality standards and to review those standards every three years. Additionally, DEQ must monitor waters to identify those not meeting water quality standards. For those waters not meeting standards, DEQ must establish TMDLs for each pollutant impairing the waters. Further, the agency must set appropriate controls to restore water quality and allow the water bodies to meet their designated uses. These requirements result in a list of impaired waters, called the “§303(d) list.” This list describes water bodies not meeting water quality standards. Waters identified on this list require further analysis. A subbasin assessment and TMDL provide a summary of the water quality status and allowable TMDL for water bodies on the §303(d) list. *Little Wood River Subbasin Assessment and TMDL* provides this summary for the currently listed waters in the Little Wood River Subbasin.

The subbasin assessment section of this report (Chapters 1 – 4) includes an evaluation and summary of the current water quality status, pollutant sources, and control actions in the Little Wood River Subbasin to date. While this assessment is not a requirement of the TMDL, DEQ performs the assessment to ensure impairment listings are up to date and accurate. The TMDL is a plan to improve water quality by limiting pollutant loads. Specifically, a TMDL is an estimation of the maximum pollutant amount that can be present in a water body and still allow that water body to meet water quality standards (Water quality planning and management, 40 CFR 130). Consequently, a TMDL is water body- and pollutant-specific. The TMDL also includes individual pollutant allocations among various sources discharging the pollutant. The EPA considers certain unnatural conditions, such as flow alteration, a lack of flow, or habitat alteration, that are not the result of the discharge of a specific pollutants as “pollution.” TMDLs are not required for water bodies impaired by pollution, but not specific pollutants. In common usage, a TMDL also refers to the written document that contains the statement of loads and supporting analyses, often incorporating TMDLs for several water bodies and/or pollutants within a given watershed.

Idaho’s Role

Idaho adopts water quality standards to protect public health and welfare, enhance the quality of water, and protect biological integrity. A water quality standard defines the goals of a water body by designating the use or uses for the water, setting criteria necessary to protect those uses, and preventing degradation of water quality through antidegradation provisions.

The state may assign or designate beneficial uses for particular Idaho water bodies to support. These beneficial uses are identified in the Idaho water quality standards and include:

- Aquatic life support – cold water, seasonal cold water, warm water, salmonid spawning, modified

- Contact recreation – primary (swimming), secondary (boating)

- Water supply – domestic, agricultural, industrial

- Wildlife habitats, aesthetics

The Idaho legislature designates uses for water bodies. Industrial water supply, wildlife habitat, and aesthetics are designated beneficial uses for all water bodies in the state. If a water body is unclassified, then cold water and primary contact recreation are used as additional default designated uses when water bodies are assessed.

A subbasin assessment entails analyzing and integrating multiple types of water body data, such as biological, physical/chemical, and landscape data to address several objectives:

- Determine the degree of designated beneficial use support of the water body (i.e., attaining or not attaining water quality standards).
- Determine the degree of achievement of biological integrity.
- Compile descriptive information about the water body, particularly the identity and location of pollutant sources.
- When water bodies are not attaining water quality standards, determine the causes and extent of the impairment.

1.2 Physical and Biological Characteristics

The Little Wood River Subbasin runs from the headwaters (in the Pioneer Mountains in Blaine County) of the Little Wood River to its mouth (west of Gooding) where it empties into the Big Wood River. It lies in the western region of the Upper Snake River Basin in Idaho. The Big Wood River, Big Lost River, Lake Walcott, and Upper Snake-Rock Subbasins surround it. The northernmost border is the Blaine County line, just above the headwaters, extending along this line south between the Blizzard and Pioneer Mountains. The eastern border runs to the east of the Little Wood River in a southwest direction south of Richfield. At this point the eastern border runs south to encompass Star Lake. The southern border then runs west to encompass a small portion of upper Jerome and upper Gooding counties to the mouth of the Little Wood River. The western border then runs to the east from the mouth just north of the Little Wood River then north along the Cottonwood Slough. The western border just catches the eastern edge of the Timmerman Hills encompassing Silver Creek drainage and continues running north of Gannet to meet the Blaine County line above the headwaters.

The climate, subbasin characteristics, subwatershed characteristics, and stream characteristics of the Little Wood River Subbasin are described in the following.

Climate

The Little Wood River Subbasin can be characterized into three basic elevation levels. The majority of the subbasin (59.0% of the area) occurs at the lower elevation range, which is less than 5,000 feet. The remainder of the subbasin (34.1% and 6.9% of the area) is found at a middle elevation of 5,000 to 7,000 feet and a higher elevation greater than 7,000 feet (ArcView Coverage 1992-1996).

These three elevation ranges will be used to describe much of the climate of the subbasin, including precipitation, air temperature and available sunlight, snow depth and snowfall, and evaporation and wind erosion. Air temperature, snowfall, and snow depth data have been collected from similar data sources. The low elevation data is an average of data from three sites (Gooding, Shoshone, and Richfield) within the subbasin at this elevation range. The middle elevation is represented by data collected from Picabo, and high elevation data is an average of data collected from Garfield and Swede Peak.

Precipitation

The weighted mean precipitation based on elevation ranges for the Little Wood River Subbasin is 14.66 inches. The majority of the precipitation occurs in the winter and spring months. The following table (Table 4) provides some precipitation data.

Table 4. Average precipitation (inches) in the Little Wood River Subbasin.

Elevation	Winter Average	Spring Average	Summer Average	Fall Average	Total Annual
High	2.81	2.51	1.48	1.19	23.97
Middle	1.62	1.25	0.69	0.46	12.10
Low	1.40	0.95	0.48	0.82	10.97

[a]Data collected from U.S. Department of Agriculture (USDA) National Resources Conservation Service (NRCS) Snotel Site and Western Regional Climate Center.

Air Temperature and Available Sunlight

The estimated midrange temperatures for the low, middle, and high elevations of the subbasin are similar to one another and are described in Table 5.

Table 5. Little Wood River Subbasin air temperature.

Elevation	Midrange Temp (°C)	Midrange Temp (°F)
High	-6.05 to 16.5	21.1 to 61.7
Middle	-5.7 to 20.2	21.6 to 68.4
Low	-4.3 to 22.2	24.2 to 72

[a]Data collected from Western Regional Climate Center (2001) and the Bureau of Reclamation (USBR) Agrimet site (2001).

The estimated average annual available sunlight for this region is 12.5 hours with the greatest amount of available light occurring in the summer months at 15 hours and the least amount occurring in the winter months at 10.5 hours (USNO 2001).

Snow Depth and Snowfall

The annual average snow depth for the low elevations of the Little Wood River Subbasin is 1.3 inches, while the annual average snow depths for the middle elevation is 2 inches (WRCC 2001). The estimated annual average total snowfall for the low, middle, and high elevations of the Little Wood River Subbasin is 43.3, 61.4, and 182.8 inches, respectively. The majority of the snowfall in the low elevations occurs from November into March. Snowfall occurs mostly from November to April in the middle elevations and from October to April in the high elevations (WRCC 2001).

Evaporation and Wind Erosion

The annual evaporation for the Little Wood River Subbasin ranges from 6 to 12 mm (0.24 to 0.47 inches) with the majority of evaporation occurring in the months of May through September (CPC 2004). Wind erosion in the Little Wood River Subbasin has been found to be so minimal as to be insignificant in its effect on the water quality of the water bodies. It has been estimated that only 3.85% of the subbasin area exceeds the threshold for wind erosion (NRCS 2001).

Subbasin Characteristics

The Little Wood River Subbasin has its main water body, the Little Wood River, flowing through the high elevations of the Pioneer Mountains, and then on through the lower flat elevation of the Lava Plains, Shoshone, and Gooding. The Little Wood River has many tributaries that originate in both the desert and mountain regions of the subbasin.

Hydrography, geology/soils, topography, vegetation, fisheries, macroinvertebrates, and water chemistry of the subbasin will be described in the following sections. The hydrology, fisheries, macroinvertebrate, and water chemistry discussions will revolve around data that has been collected on the 303(d) listed streams in the subbasin.

Hydrography

There are a number of natural and anthropogenic activities occurring in the Little Wood River Subbasin that impacts the hydrology of the subbasin. Figure 3 depicts the average hydrograph for several of the water bodies. Peak flows tend to occur at the first of the summer in June, followed by smaller runoff events that change the shape of the hydrograph in April, May, July, and August.

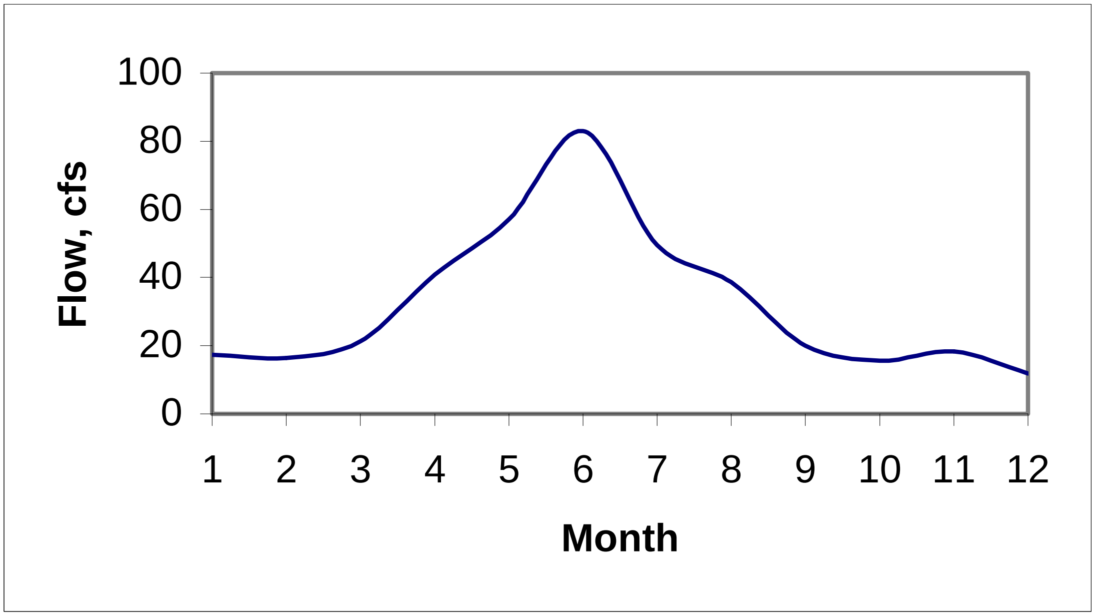

Figure 3. Little Wood River Subbasin average hydrology.

The figure indicates that there may be many natural and anthropogenic activities altering the natural hydrograph of the subbasin. For example, ground water influences portions of the Little Wood River Subbasin substantially. The Silver Creek drainage is a large spring-fed system that lies in the middle portion of the Little Wood River Subbasin. There are also three large reservoirs/lakes and several small alpine lakes that lie within the Little Wood River Subbasin. The reservoirs/lakes include Carey Lake, the Little Wood River Reservoir, and Fish Creek Reservoir:

- Carey Lake is the natural outlet for the Fish Creek drainage and is also fed by surrounding hot springs.
- The Little Wood River Reservoir is the largest reservoir in the subbasin. It lies in the upper third portion of the subbasin and has direct impacts to the hydrology of the remainder of the river located downstream.
- Fish Creek Reservoir is the second largest reservoir in the subbasin and greatly influences the natural hydrology of the Fish Creek system. Additionally there are several other small reservoirs within the subbasin.

The Little Wood River is the natural outlet for all of the water of the Little Wood River Subbasin. The Little Wood River runs from the mountainous headwaters in the north of the subbasin to the flatter agricultural lands at the mouth in the southwest portion of the subbasin. Many snow pack driven creeks feed the upper portion of the river. These creeks contribute to the perennial nature of the river as a whole and to a hydrology that would likely be expected for the subbasin as a whole excluding flow manipulations.

The hydrology of the middle portion of the river is changed substantially by the Little Wood River Reservoir and downstream irrigation water demands. Irrigation water demands within the subbasin leads to peak flows that occur within irrigation months (summer and early fall) rather than during spring runoff. The reservoir storage and irrigation demands also leads to segments of the river that remain dry throughout the year.

Many anthropogenic activities and natural water sources also impact the lower portion of the river. The lower portion of the subbasin contains many natural spring-fed systems, which feed the Little Wood River downstream of the Silver Creek confluence. These systems yield a continuous stable flow for much of the river above Richfield. However, the irrigation demands and the resulting dewatered segment above the spring systems confluence contribute to a pronounced lack of peak flushing flows in the lower segment. Irrigation water transport and use also impacts summer time peak flows in this portion of the river.

The above mentioned hydrologic impacts to the Little Wood River can also be seen in many of the smaller systems of the subbasin. Overall, these impacts yield a subbasin with a non-typical annual hydrograph. The hydrology of the individual water bodies within the subbasin is discussed in Section 2: Subbasin Assessment – Water Quality Concerns and Status.

The annual average hydrographs for the Little Wood River and the smaller systems will be developed from U.S. Geological Survey (USGS) gage data and flow records collected by DEQ and other agencies. To date, there have been 11 gage stations in the Little Wood River Subbasin (Figure 4). These gages have been located on the Little Wood River, Silver Creek, Fish Creek, and West Fork Fish Creek. Three of these gage stations have historical and current data, while the remaining gauges have only historical flow data. The current gage stations include two on the Little Wood River and one on Silver Creek. Table 6 identifies the gauging stations in the Little Wood River Subbasin and their period of record.

Table 6. USGS Gage stations located in the Little Wood River Subbasin.

Gage ID	Water Body Name	Gauge Name	Period of Record
13147900	Little Wood River	Little Wood River AB High Five Creek NR Carey ID	1958 - 2002
13148000	Little Wood River	Little Wood River at Campbell Ranch NR Carey ID	1920 - 1958
13148500	Little Wood River	Little Wood River NR Carey ID	1925 - 2002
13149000	Fish Creek	Fish Creek AB Fish Creek Dam NR Carey ID	1920 - 1939
13149500	West Fork Fish Creek	WF Fish Creek NR Carey ID	1920 - 1929
13150000	Fish Creek	Fish Creek NR Carey ID	1919 - 1939
13150430	Silver Creek	Silver Creek at Sportsman Access NR Picabo ID	1974 - 2002
13150500	Silver Creek	Silver Creek at Hwy 20 NR Picabo ID	1920 - 1962
13151000	Little Wood River	Little Wood River NR Richfield ID	1911 – 1972
13151500	Little Wood River	Little Wood River at Shoshone ID	1922 – 1959
13152000	Little Wood River	Little Wood River at Toponis ID	1896 - 1897

[a]Gage data gathered from U.S. Geological Survey Web site (2004).

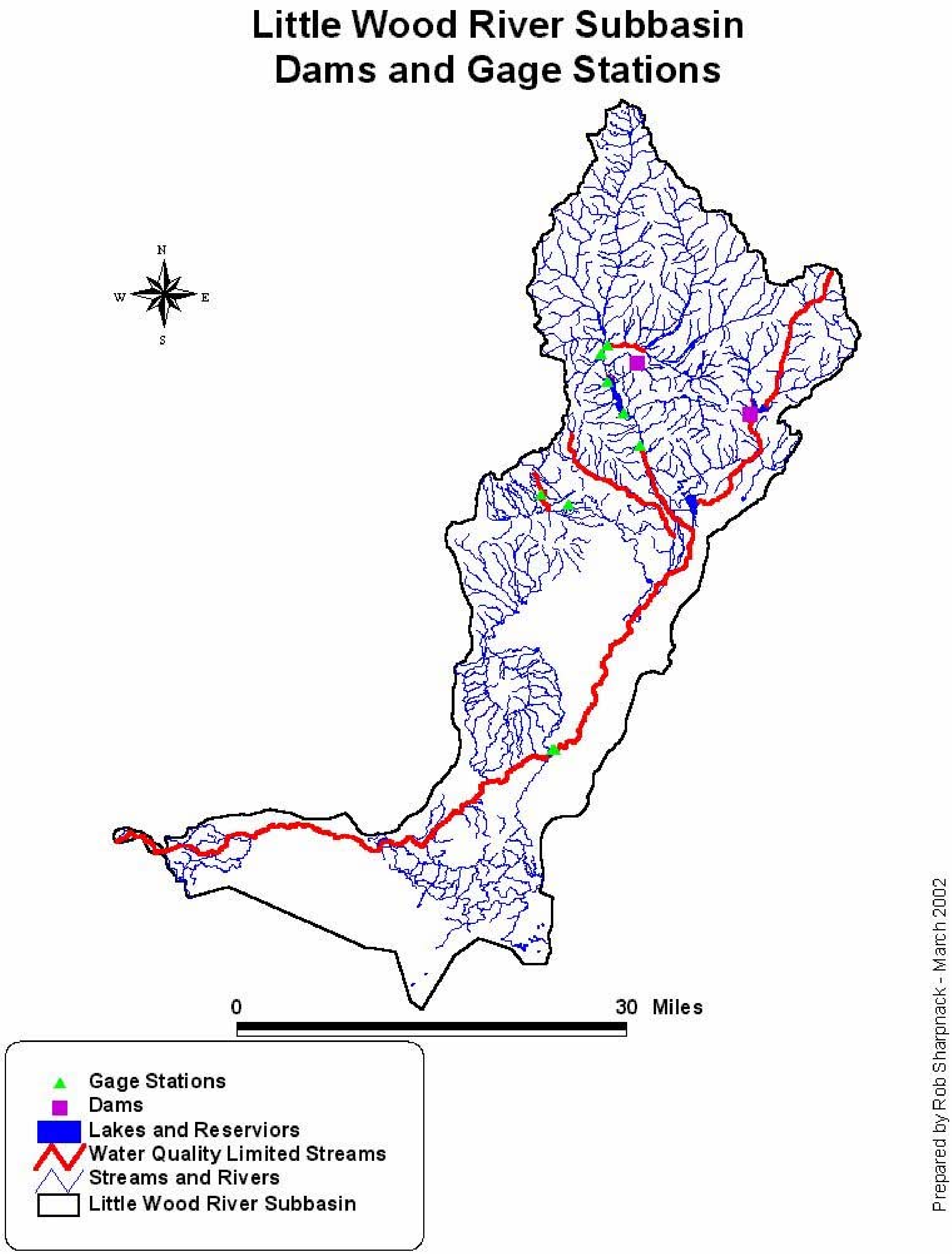

Figure 4. Little Wood River Subbasin dams and gauge stations.

Geology and/or soils

The geology and soils of a subbasin can identify areas that may be impacted more by natural events than by as anthropogenic activities. This section describes the geologic formations of the subbasin as well as characteristics of the soil of the subbasin.

The Little Wood River Subbasin consists of two ecoregions: the Snake River Basin/High Desert and the Northern Rockies. The Snake River Basin/High Desert covers 76.9% of the area in this subbasin while the Northern Rockies cover the remaining 23.1% in the northern watersheds (ArcView Coverage, 1992-1996). Transitional zones occur within the subbasin where the characteristics of the ecoregions intersect one another, however these transition zones account for a small portion of the subbasin and are not represented in ArcView coverage.

There are three geomorphology types in the Little Wood River Subbasin. The high mountainous elevations are alpine glacial (erosional), while the foothills of the subbasin are fluvial. The lower elevations are plateau and account for slightly over half of the subbasin area (ArcView, 1992-1996).

There are 24 geologic formations occurring in the Little Wood River Subbasin (Figure 5). The three predominate geologic formations within the subbasin are silicic and basaltic volcanic ejecta flows found in the northern portion of the subbasin, basalt flows found in the middle portion, and lava flows found in the southern portion of the subbasin. Table 7 describes the geologic formations within the subbasin.

The K factor of soil is a measure of the susceptibility of soil to erosion and the rate of runoff of the soil. Soils with K factor values of 0.05 to 0.15 are resistant to detachment, soils with K factor values of 0.05 to 0.2 tend to be easily detached but have low runoff. The soils with higher K factors of 0.25 to 0.4 are moderately susceptible to detachment and have moderate runoff. The soils with K factors of 0.4 or greater are easily detached and have high rates of runoff (MSU 2005).

The majority of the subbasin has soil K factors of 0.15 to 0.25 and 0.25 to 0.35 (Figure 6). The upper portion of the subbasin consists mostly of soils with soil K factors of 0.25 to 0.35. There is a small quantity of more erosive soils (0.35 to 0.45) that lie along the valley floor along the Little Wood River above the reservoir, Muldoon Creek, and Fish Creek near the reservoir. The lower portion of the subbasin consists mostly of soils with soil K factors of 0.15 to 0.25 with a small portion of land that has K factors that are more erosive (0.25 to 0.35) upstream of Shoshone.

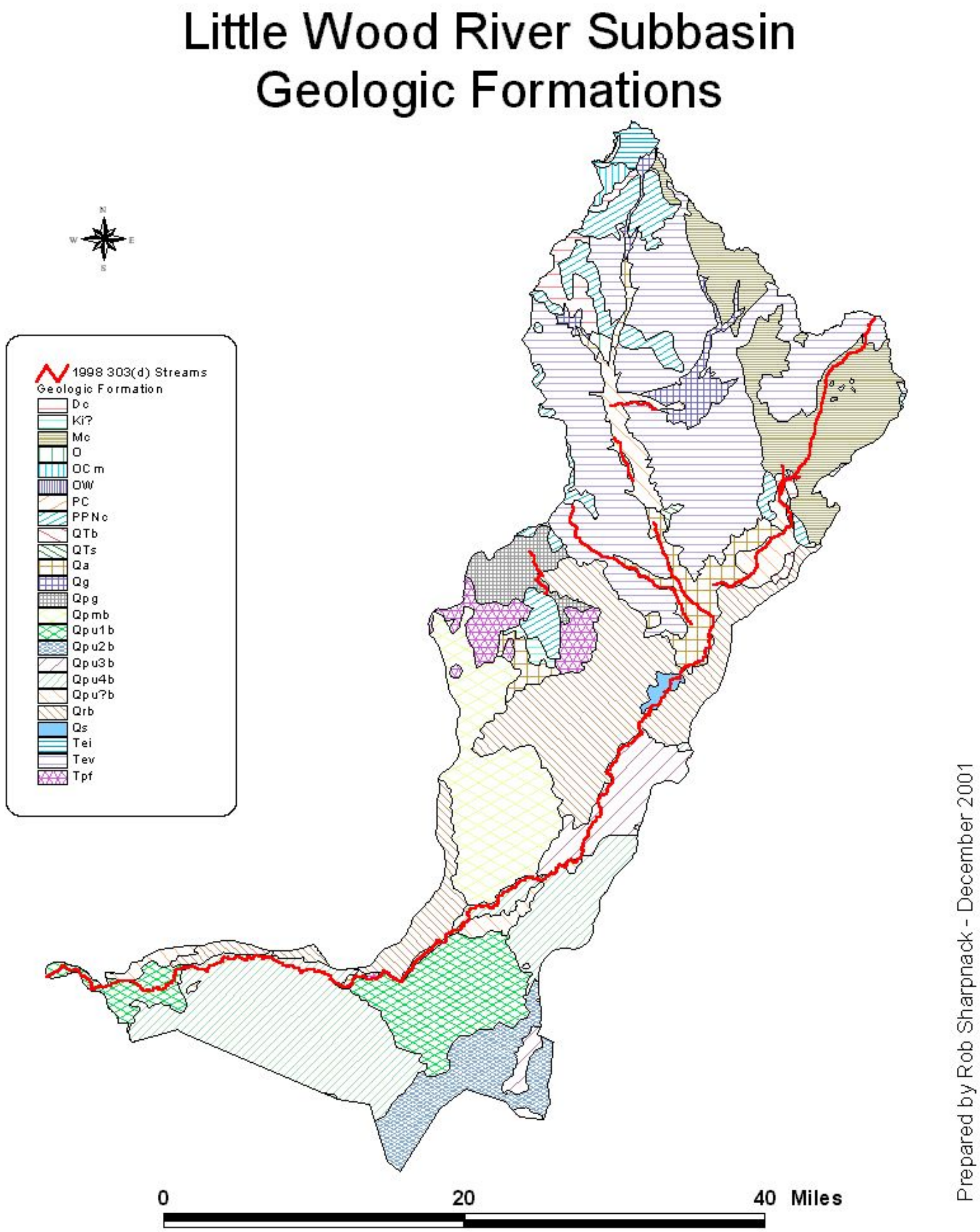

Figure 5. Geologic formations of the Little Wood River Subbasin.

Table 7. Geologic formations of the Little Wood River Subbasin.

Code	Description	Percent of Subbasin
Dc	Devonian thrusted deep-water siliceous argillite and quartzite of central	1.2
Ki?	Cretaceous plutons	0.2
Mc	Mississippian thrusted shallow-to-deep marine detrital units of central Id	8.4
O	Ordovician marine dolomite quartzite and limestone	0.1
Ocm	Achist quartzite and other metasediments of probable Lower Ordovician to	0.3
OW	Open Water	0.0
PC	Precambrian high-grade metamorphic rocks	0.0
PPNc	Lower permian to Middle pennsylvanian thrusted marine detritus of central	4.5
QTb	Lower Pleistocene to Pliocene basalts with associated tuffs and volcanic det	0.2
QTs	Pleistocene and Pliocene stream and lake deposits	0.1
Qa	Quaternary alluvium	4.0
Qg	Quaternary colluvium fanglomerate and talus	1.7
Qpg	Pleistocene outwash fanglomerate flood and terrace gravels	2.0
Qpmb	Middle Pleistocene plateau and canyon-filling basalt in and near Snake Plai	7.4
Qpu1b	Upper Pleistocene Snake Plain lava flows	6.9
Qpu2b	Upper Pleistocene Snake Plain lava flows	4.1
Qpu3b	Upper Pleistocene Snake Plain lava flows	3.4
Qpu4b	Upper Pleistocene Snake Plain lava flows	13.5
Qpu?b	Upper Pleistocene Snake Plain lava flows	3.4
Qrb	Recent relatively unweathered Snake Plain basalt flows and cinder condes	13.4
Qs	Quaternary surficial cover	0.3
Tei	Eocene intrusions	0.6
Tev	Eocene mixed silicic and basaltic volcanic ejecta flows and reworked debr	22.1
Tpf	Pliocene silicic and welded tuff ash and flow rocks	2.2

[a]Data from ArcView Coverage, 1992-1996.

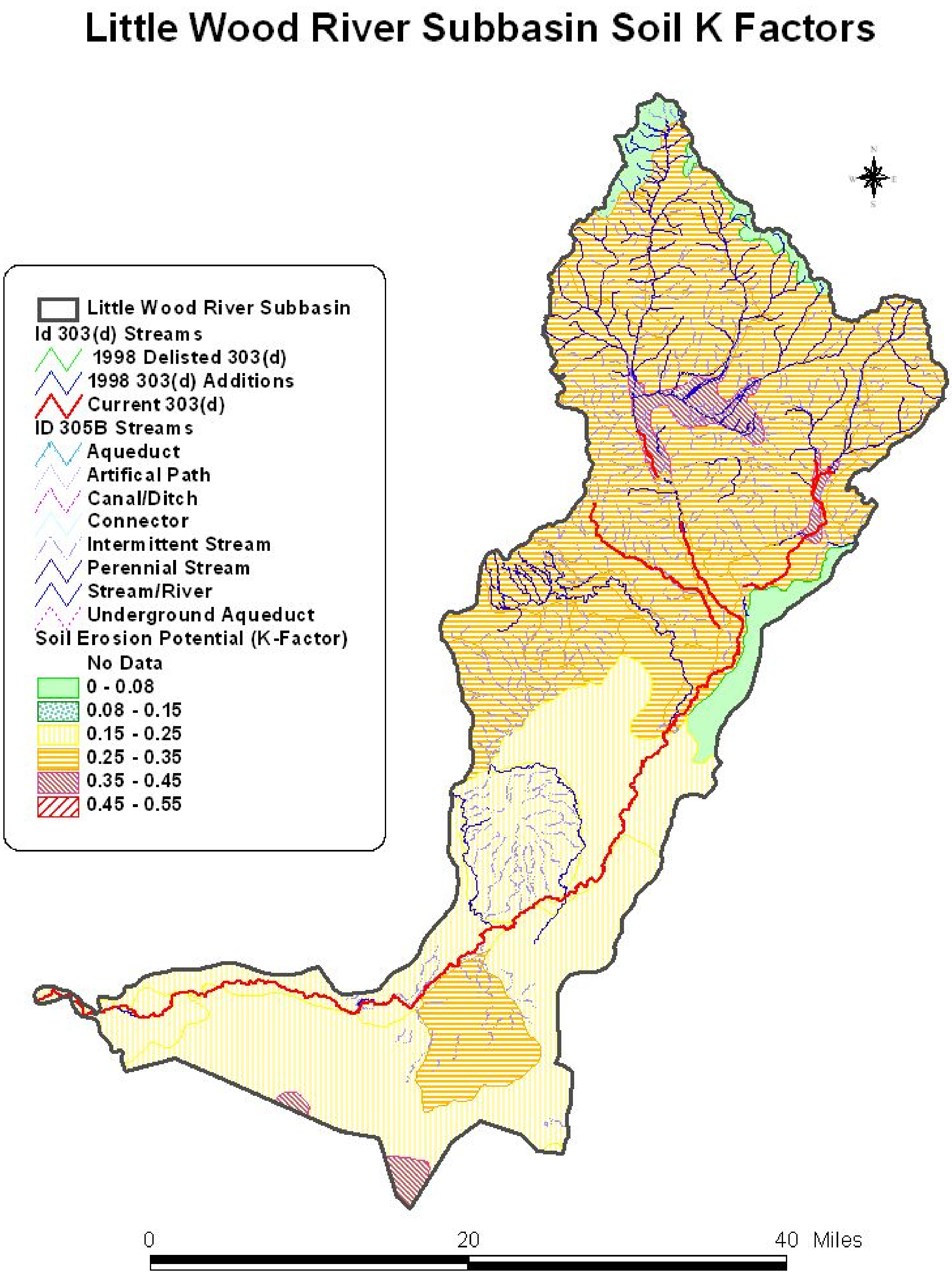

Figure 6. Soil erosivity (K Factors) of the Little Wood River Subbasin.

Topography

The Little Wood River flows north to south in the upper third of the subbasin, northwest to southwest in the middle portion of the subbasin, and east to west in the lower half of the subbasin. The Little Wood River Subbasin extends from the basin divide line, which is about 0.1 miles beyond the headwaters, to the mouth, which empties into the Big Wood River. The subbasin is about 84.8 miles long and has an elevation difference of 6,430 feet. These characteristics yield a subbasin slope of about 1.44 %.

Three elevation ranges can characterize the Little Wood River Subbasin: low, middle, and high. These ranges were described previously in the climate section. The lowest elevation in the subbasin occurs at the mouth (3,412 ft). Some of the higher elevations occur at Garfield (8,530 ft), Blizzard (8,530 ft), and Elk Mountains (8,040 ft). The highest elevations in the subbasin are at Scorpion Mountain (10,500 ft), Grays Peak (10,560 ft) and unnamed peaks (11,020 ft).

Vegetation

The vegetation coverage of the Little Wood River Subbasin varies and is illustrated in Figure 7. Barren rock, urban/developed, water, riparian, wetlands, and disturbed vegetation account for about 3.9% of the Little Wood River Subbasin area. Shrubland is the largest vegetation cover for the subbasin (57.8% of the area). Agriculture and grassland vegetation cover is similar in coverage (16.4% and 13.8% of the area). Forested vegetation makes up the last vegetation type (7.9% of the area) and occurs in the northernmost areas of the subbasin (ArcView Coverage 1992-1996).

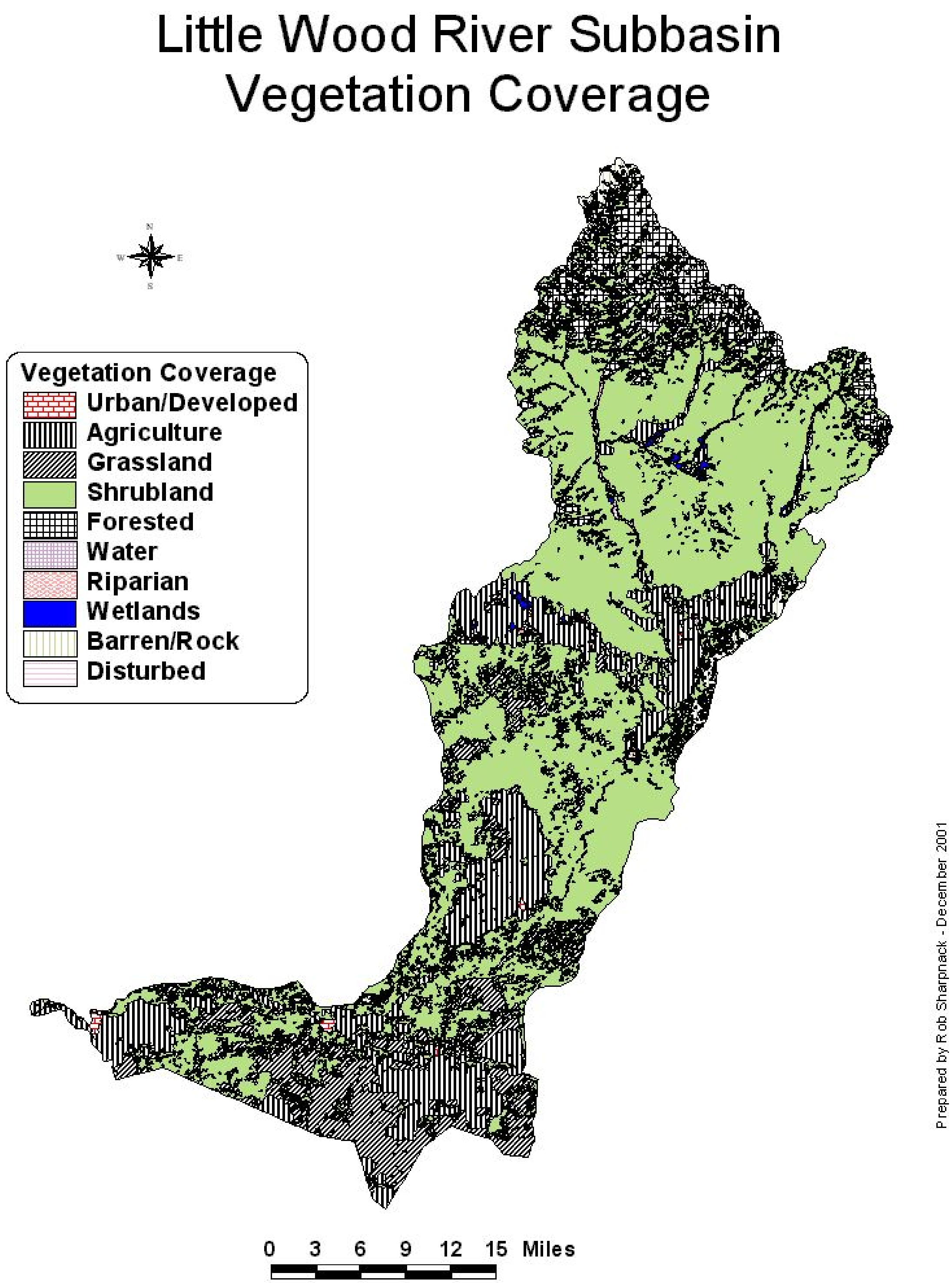

Figure 7. Vegetation coverage of the Little Wood River Subbasin.

Biological Communities

The presence of endangered, threatened, or sensitive species can impact the way in which the land of the subbasin is managed. There are a number of endangered, threatened, or sensitive species within the counties of the Little Wood River Subbasin. *These species are a concern within the counties but not necessarily found within the subbasin itself* (Appendix B).

Some of these species are aquatic or depend upon the aquatic environment at some point in their life cycle. The bald eagle winters and nests in the area and feeds on fish within the streams. Some species of concern found within the subbasin are redband trout and Wood River sculpin. Bull trout are listed as a threatened species in Blaine County, however they do not occur within the Little Wood River Drainage. Any bull trout that may be occurring there are non-native (Warren 2001).

Fisheries can be a good indicator of the water quality status of a water body since the thermal requirements of fish have been fairly well studied (Grafe et all 2002). Fish in the northwest are identified as cold, cool, or warm water species and can be classified with overall pollution tolerance values of sensitive, tolerant, or intermediate (Zaroban et al., 1999). There are many species of fish that are found within the waters of the Little Wood River Subbasin. The fish in the subbasin are identified, along with their temperature preference and tolerance values (Table 8).

Table 8. Fisheries of the Little Wood River Subbasin.

Family	Species	Temperature preference	Tolerance value
Salmonidae	Rainbow trout	Cold water	S
	Brook trout	Cold water	I
	Brown trout	Cold water	I
	Mountain whitefish	Cold water	I
Cottidae	Wood River sculpin	Cold water	S
	Sculpin sp		
Catostomidae	Bridgelip sucker	Cool water	T
	Sucker sp	Cool water	
	Utah sucker	Cool water	T
Cyprinidae	Speckled dace	Cool water	I
	Longnose dace	Cool water	I
	Dace sp	Cool water	
	Redside shiner	Cool water	I
	Utah chub	Cool water	T
	Common carp	Warm water	T

[a]Species accumulated through various collection events.
[b]S – Sensitive, I – Intermediate, T – Tolerant.

The Wood River sculpin is a cold water species that is sensitive to pollution and endemic to the Wood River drainage. Idaho Fish and Game (IDFG) considers it to be a species of special concern and the U.S. Forest Service (USFS) and U.S. Bureau of Land Management (BLM) consider it to be a sensitive species. These classifications are a result of the lack of knowledge about the range of the species, the land management impacts to the habitat of the Wood River sculpin, and the impacts to the species from competitive species (Zaroban 2003). These characteristics could make this species an excellent indicator of water quality trends within the subbasin if intensive surveys were completed in the Wood River drainage.

Benthic macroinvertebrates have limited migration patterns, which makes them good indicators of environmental conditions (Grafe et all 2002). An analysis of the macroinvertebrates on the 303(d) listed stream was preformed, yielding the following results:

- The stream macroinvertebrate index (SMI), the average of nine metric indices, is an overall indicator of the health of a stream. The majority of the sites within the subbasin rated as fair to very poor for the SMI rating.
- Taxa richness is a metric that measures the health of the community by a measure of the variety of taxa present. Generally, as habitat quality increases so too does taxa richness. Taxa richness for the subbasin was low in relation to other studies done in southern Idaho.
- The pollution tolerance value indicates how tolerant a species is to pollution and ranges from 0 to 11. A lower number indicates intolerance. The Little Wood River Subbasin rated as good to fairly poor for pollution tolerance values.
- The numbers of Ephemeroptera and Plecoptera taxa are metrics that can indicate temperature and fine sediment pollution. As the number of these taxa increase so to does water quality. This index score in the subbasin ranged from 0-52%.
- The percent scrapers metric decreases as fine sediment increases within a system. The percent clingers metric decreases as habitat disturbance increases. The number of scraper and clinger taxa within the subbasin was both low.
- Low numbers of cold water taxa indicate that land use and pollutants are impacting a water body. There were few cold water indicator species and counts of each cold water species were very low.

Overall, the macroinvertebrate data in the Little Wood River Subbasin seem to indicate that the water bodies in the subbasin appear to be impacted by sediment and temperature (Clark 2003).

Water Chemistry

Seasonal peaks for sediment, nutrients, and bacteria occur in the Little Wood River Subbasin. Data collected during the 2001-2003 period was used to determine peak discharge of pollutants in the subbasin. Monthly data from all monitoring sites were averaged together to represent the annual graph for the subbasin.

Suspended load constitutes both washload and suspended bed-material load. Washload comes from the banks and upland areas and can remain in suspension during low velocities. Suspended bed-material load is transported with the washload by turbulent water and will drop out when velocities decrease (Gordon et.al., 1992). Sediment in the subbasin was measured in the form of total suspended solids (TSS). Figure 8 depicts the average discharge of TSS in the Little Wood River Subbasin. *There are two peak discharges of TSS, the first peak occurs during the spring runoff and the second peak occurs in early fall during base flow events.* Higher concentration of TSS would be expected during spring runoff as the stream flows would likely be higher and more washload and suspended bed-material would be transported. A peak in the fall is less likely to be expected as velocities are low and are less likely to be carrying suspended bed-material loads. The peak is likely due to anthropogenic activities occurring in the subbasin, although late season precipitation events could also contribute to sediment loads during base flow events.

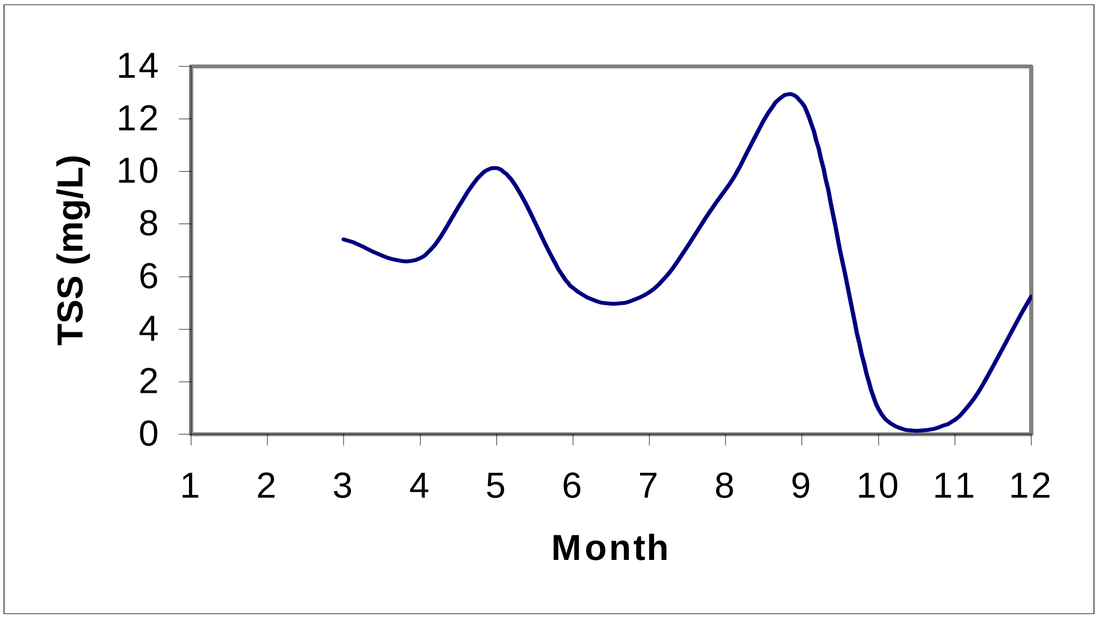

Figure 8. Average annual TSS in the subbasin.

Nitrogen and phosphorous are two components necessary for the growth of aquatic plants within a water body. In most freshwater systems phosphorous is the limiting factor because it has a tendency to bind with other elements or sediment and be taken out of the cycle (Stream corridor restoration, 1998). Nutrients in the Little Wood River Subbasin were measured in the form of total phosphorous (TP). Figure 9 depicts the average annual discharge of TP in the Little Wood River Subbasin. *There are two peak discharges of TP, the first occurs during the spring runoff and the second occurs in early fall during base flow events.* Peak discharges of TP in the runoff period would be expected as sediments are generally transported during high flows. The TP quantity would be elevated because TP has a high tendency to bind with sediments, therefore as sediment is transported so to is TP. The TP peak in the fall is less likely to occur due to low flow conditions therefore this event is likely due to anthropogenic activities, senescence of aquatic plant material, or late season precipitation events.

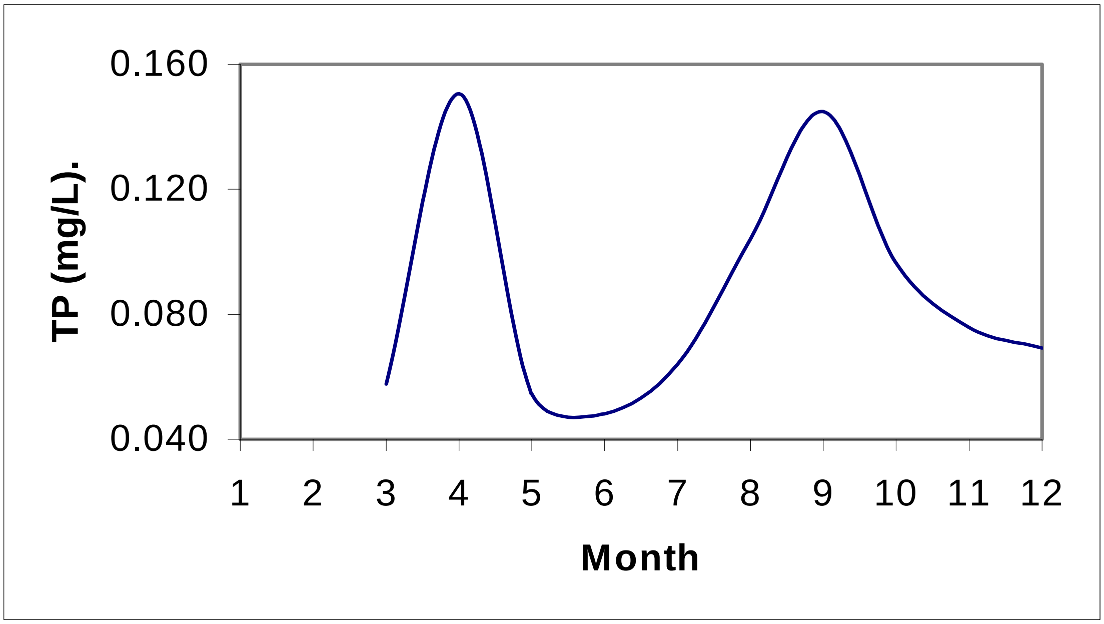

Figure 9. Average annual TP in the subbasin.

There are apt to be fluctuations in the bacteriological content of water in surface waters. These fluctuations tend to occur in the spring and fall when snow melt and rainfall introduce wash from the surrounding lands (Prescott 1931). Bacteria in the Little Wood River Subbasin were measured in the form of *Escherichia coli* (*E. coli*). Figure 10 depicts the average annual discharge of *E. coli* in the subbasin. *There are elevations in E. coli at various times through the spring into the fall.* The elevations seen during the summer are likely due to anthropogenic activities such as grazing. During this time period, instream flows are at base flow conditions. During base flows, direct impacts to the water body from grazing or leaking septic systems are more likely to occur.

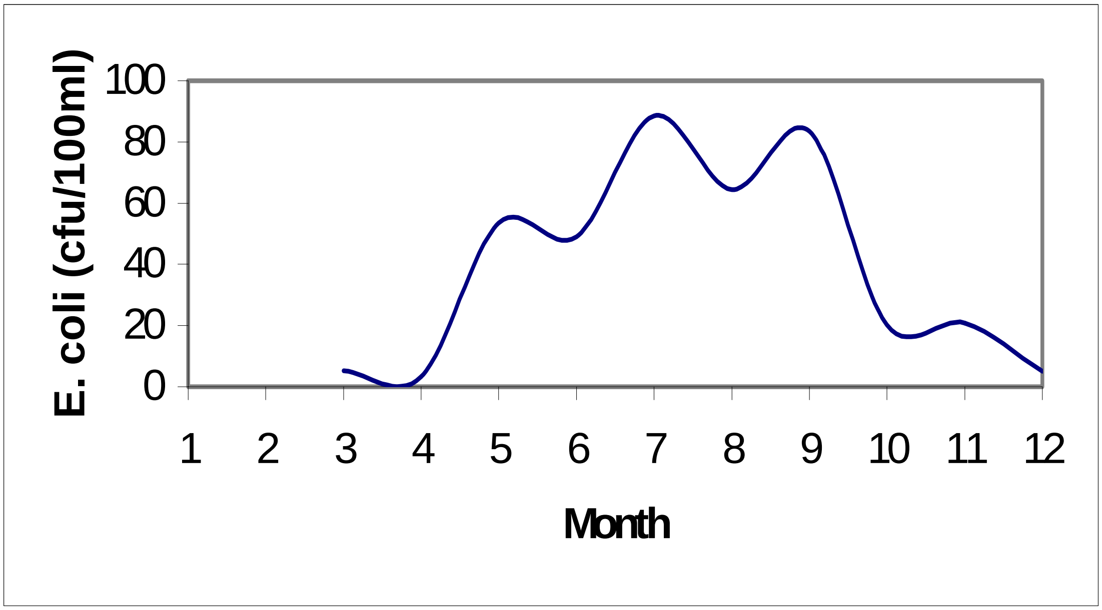

Figure 10. Average annual *E. coli* in the subbasin.

Subwatershed Characteristics

The Little Wood River Subbasin is characterized by ten 5th field Hydrologic Unit Codes (HUCs) referred to as subwatersheds. The subwatersheds of the subbasin and their attributes are described in the following sections.

5th field Hydrologic Unit Code (HUC)

The Little Wood River Subbasin consists of ten watersheds of the 5th field HUC category (ArcView Coverage 1992-1996). Each of these watersheds drains into the tributaries of the Little Wood River or into the Little Wood River itself, with the exception of Dry Creek and it's tributaries. Dry Creek currently does not connect with the Little Wood River directly. However, it does flow into the West Canal of the Little Wood River Irrigation District, which does flow into the Little Wood River. These watersheds will be the divisions used to aid in the implementation process to restore beneficial uses of the 303(d) listed streams.

Watershed Area

The watershed areas of the subbasin are described in Table 9 and illustrated in Figure 11.

Table 9. Little Wood River Subbasin 5th field HUC watershed areas.

5^{th} Field HUC	Name	Associated 1998 303(d) Creek	Area (km^2)	Subbasin Area (%)
17040221-01	Lower Little Wood River	Little Wood River	118.8	20.8
17040221-02	Main Canal	Little Wood River	412.3	14.1
17040221-03	Middle Little Wood River	Little Wood River	417.8	14.3
17040221-04	Silver Creek	Loving Creek	188.0	6.4
17040221-05	Little Wood River Reservoir	Little Wood River and reservoir, Dry Creek	373.5	12.8
17040221-06	Upper Little Wood River	Muldoon Creek	439.8	15.0
17040221-07	Muldoon Creek	Muldoon Creek	144.5	4.9
17040221-08	Friedman Creek	None	28.5	1.0
17040221-09	Fish Creek Reservoir	Fish Creek and reservoir	197.1	6.7
17040221-10	Fish Creek	Fish Creek	118.4	4.0

[a]Data from ArcView Coverage, 1992-1996.
[b]1998 303(d) refers to a list created in 1998 of water bodies in Idaho that did not fully support at least one beneficial use. This list is required under section 303 subsection “d” of the Clean Water Act.

Figure 11. Little Wood River 5th field watersheds.

Watershed attributes can help indicate what factors may be influencing water quality in a given watershed. Table 10 provides information on watershed attributes for the various watersheds of the Little Wood River. A brief description of these attributes follows.

Table 10. Little Wood River Subbasin watershed attributes.

5th Field HUC	Land form	Dominant Aspect	Relief ratio	Mean elevation (m)	Dominant slope	Hydrologic regime	Unit area runoff (ton/acre/yr)
17040221-01	SRB/HD	E to W	0.006	1209	2.2	CON	81.6
17040221-02	SRB/HD	NE to SW	0.018	1404	3.3	ANN + PARA	96.7
17040221-03	SRB/HD	NE to SW	0.018	1400	3.8	NONE	50.3
17040221-04	SRB/HD	NW to SE	0.022	1573	6.2	PARA + CON	81.6
17040221-05	SRB/HD + NR	N to SW	0.026	1742	4.6	DEND	175.9
17040221-06	NR + SRB/HD	N to S	0.061	2157	7.3	DEND	818.4
17040221-07	NR	NW to SW	0.067	2368	10.8	DEND	207.5
17040221-08	NR	NE to SW	0.105	2322	22.4	DEND	14.5
17040221-09	NR + SRB/HD	NE to SW	0.055	2011	9.2	CON	110.7
17040221-10	SRB/HD	N to SW	0.048	1671	10.7	CON	49.9

[a] Data from Buhidar 2002.
[b] LF – landform, DA-dominant aspect, RR-relief ration, ME-mean elevation (meters), DS-dominant slope (percent), HR-hydrologic regime, UAR- unit area runoff (ton/acre/year) based on RUSLE equation for entire 5th field HUC.
[c] SRB/HD – Snake River Basin / High Desert, NR – Northern Rockies, E – East, W – West, N – North , S – South, CON – Contorted, ANN – Annual, PARA – Parallel, DEND – Dendritic.

Landforms are recognizable formations or features of the land that have a characteristic shape and are produced by natural causes (NWOSSP, 2004). The landforms have been identified based on ecoregions. In the case of watersheds of the Northern Rockies (NR), the landforms that are present are sharp-crested, steep sloped high mountains. For those of the Snake River Basin High Desert (SRB/HD) characteristic landforms are tablelands with moderate to high relief plains with hills or low mountains. Both of these landforms are found throughout the watersheds of the Little Wood River Subbasin.

As can be seen, there are many traits that can characterize a region, and these traits are defined as follows.

- *Dominant aspect* of a watershed indicates the direction of the flow of the dominant stream of a watershed.
- *Relief ratio* represents the difference in the elevations of the watershed divided by the watershed length.

- *Dominant slope* is a percentage that indicates the slope of the watershed by dividing the mean elevation by the watershed length.
- *Hydrologic regime* summarizes the drainage patterns of the watershed. In the case of the Little Wood River Subbasin the patterns are contorted, annual, parallel, and dendritic. Contorted drainages are found in coarsely layered metamorphic rocks and annual drainages may form rings around circular underground structures, such as domes and basins. Parallel drainages occur where water bodies flow parallel to one another due to the terrain characteristics and usually indicates moderate to steep slopes, and dendritic branches are drainage with a branch like pattern that occurs in areas with uniform rock with little folding or faulting and gentle regional slopes (Ritter, 1978, ISAS, 2004).
- *Unit area runoff* is an estimate based on RUSLE sediment model of the amount of erosion that occurs within a watershed in a single year.

1.3 Cultural Characteristics

Human activity can affect the water quality of a water body, either by directly influencing the water or by degrading the land around the water body, which, in turn, can affect the water. The following section will describe some of the human activities that may be influencing the water quality in the Little Wood River Subbasin, including land use, land ownership, cultural features, population, history, and economics.

Land Use

Rangeland is the major land use in the Little Wood River Subbasin, accounting for 73.2% of the subbasin area and can be found throughout the entire stretch of the subbasin. There is forestry in the northern portion of the subbasin in the Sawtooth National Forest (5.0%) and rock in the lava plain area (2.2%). Dispersed throughout the subbasin there is irrigated agriculture, gravity flow accounts for 13.8% and sprinkler accounts for 5.8% of the subbasin area (ArcView Coverage, 1992-1996). See Table 11 and Figure 12 for land use within the subbasin.

Table 11. Land use of the Little Wood River Subbasin.

Land use	Area (km^2)	Percent of subbasin
Rangeland	2146.9	73.2
Irrigated-gravity flow	404.7	13.8
Irrigated-sprinkler	170.1	5.8
Forest	146.6	5.0
Rock	64.5	2.2

[a] Data from ArcView coverage 1992-1996.

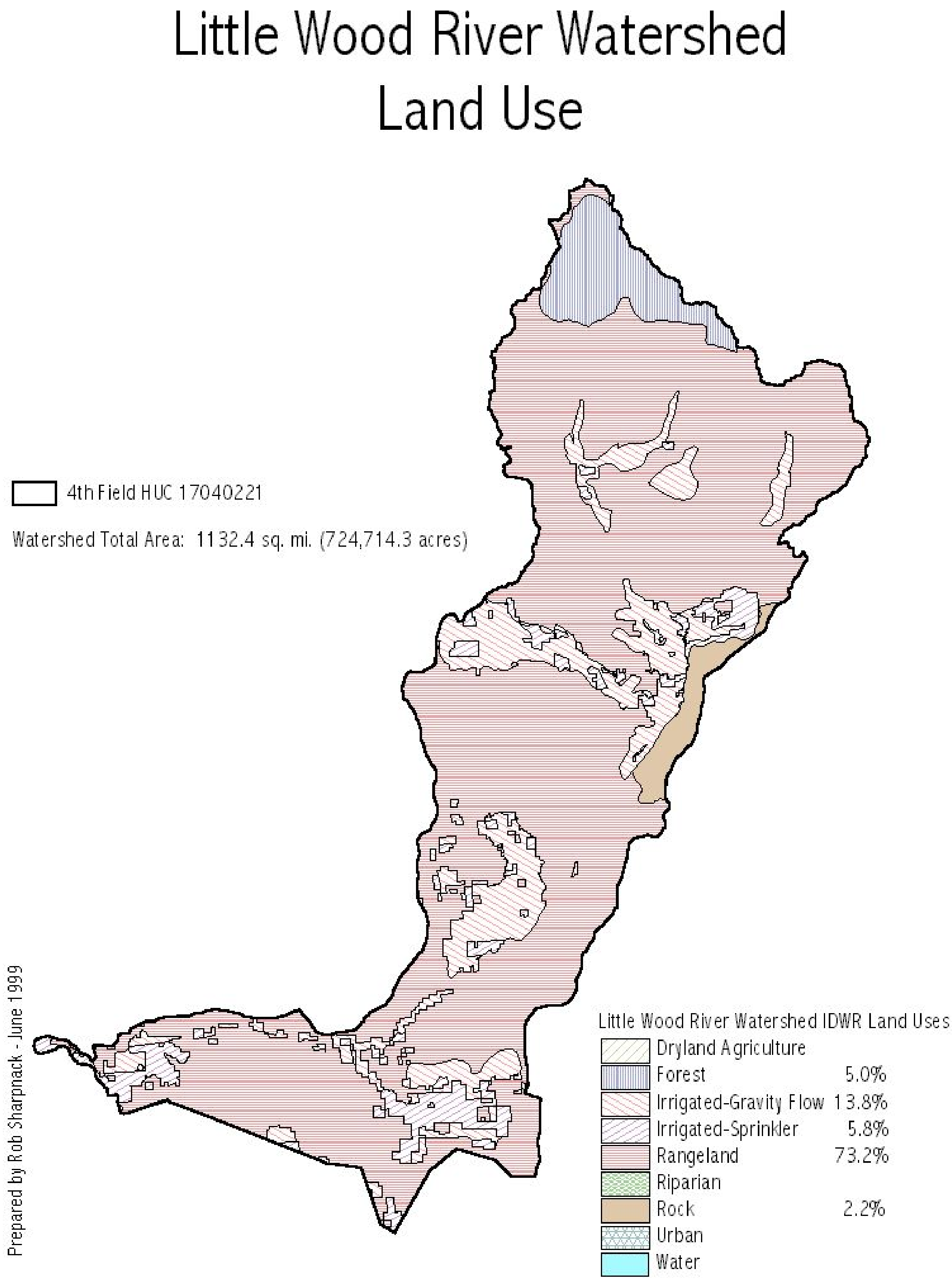

Figure 12. Little Wood River Subbasin land use.

Land Ownership, Cultural Features, and Population

The Little Wood River Subbasin is either privately owned (40.4%) or publicly owned and managed by BLM (43.6%). The remainder is open water (0.2%), publicly owned and managed by the state of Idaho (5.9%), or publicly owned and managed by the USFS (9.9%) (ArcView Coverage, 1992-1996). See Table 12 for a summary of land ownership in this subbasin.

Table 12. Land ownership in the Little Wood River Subbasin.

Land Ownership	Area (km^2)	Percent of subbasin
BLM	1277.4	43.6
Open water	5.7	0.2
Private	1183.1	40.4
State of Idaho	171.2	5.9
U.S. Forest Service	291.1	9.9

[a] Data from ArcView coverage 1992-1996.
[b] State of Idaho land is classified into three groups of lands, endowment land (managed by Idaho Department of Lands) accounts for approximately 162.6 km^2 of state land, lands managed by the Idaho Department of Fish and Game accounts for approximately 4.5 km^2 of state land, and land managed by the Idaho Department of Parks and Recreation accounts for approximately 1.6 km^2 of the state land in the subbasin.

The Little Wood River Subbasin lies within four counties (Figure 13). The majority of the subbasin (58.6%) lies in Blaine County (663.1 square miles) and Lincoln County (37.0%—419 square miles). An extremely small portion lies in Jerome County (1.4%—15.4 square miles) and Gooding County (3.0%—34.5 square miles) (ArcView Coverage, 1992-1996).

The Little Wood River runs through three of the seven towns that exist in the Little Wood River Subbasin (Figure 14), including Carey, Shoshone, and Gooding. The remaining towns in the subbasin are Richfield, Picabo, Gannett, and Dietrich. The population for the Little Wood River Subbasin is estimated at 8,669. Thirty two percent of the total population is rural. In the last ten years, the population of the Little Wood River Subbasin has increased 20%. (IDOC, 2001).

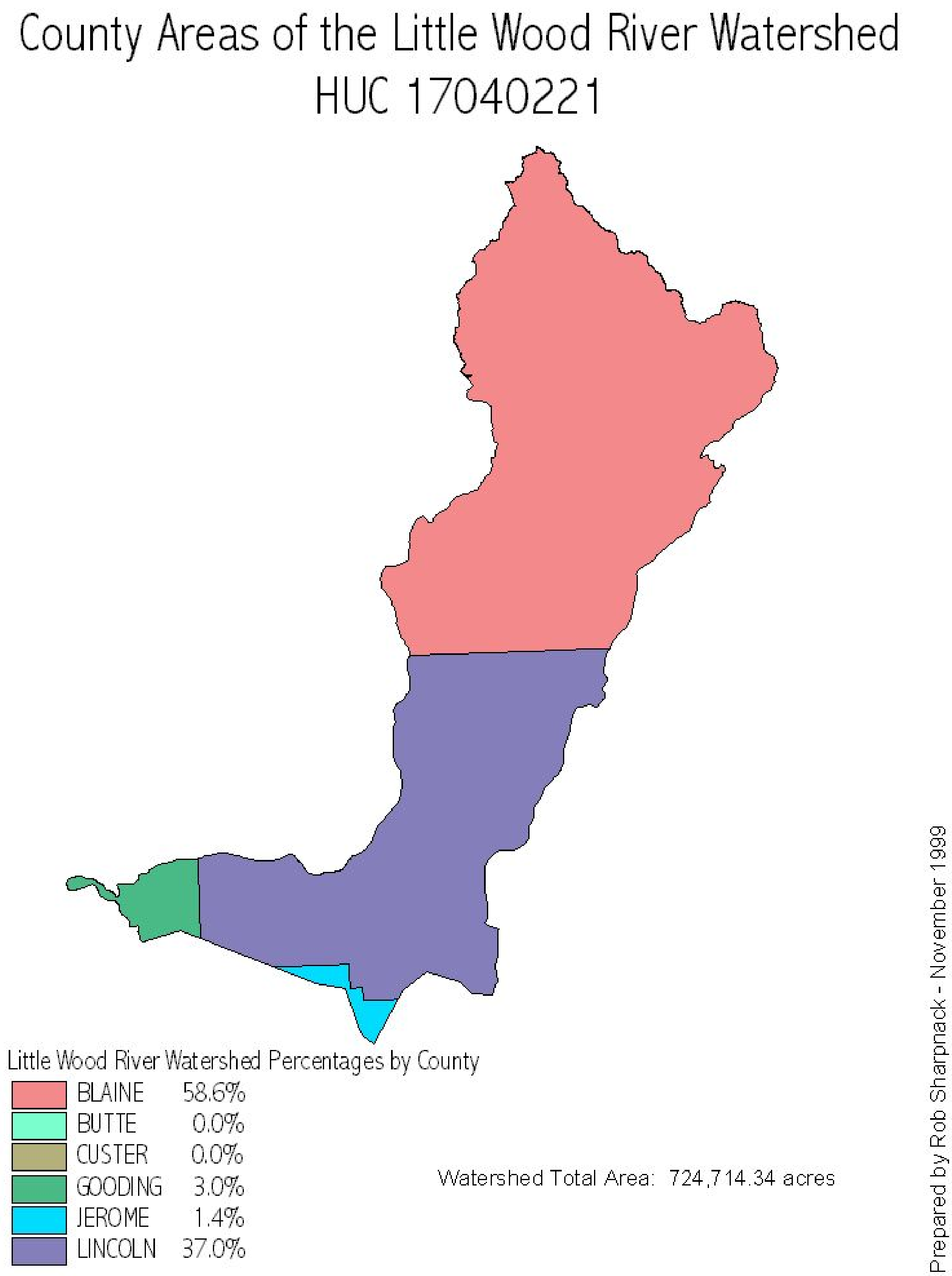

Figure 13. Little Wood River Subbasin counties.

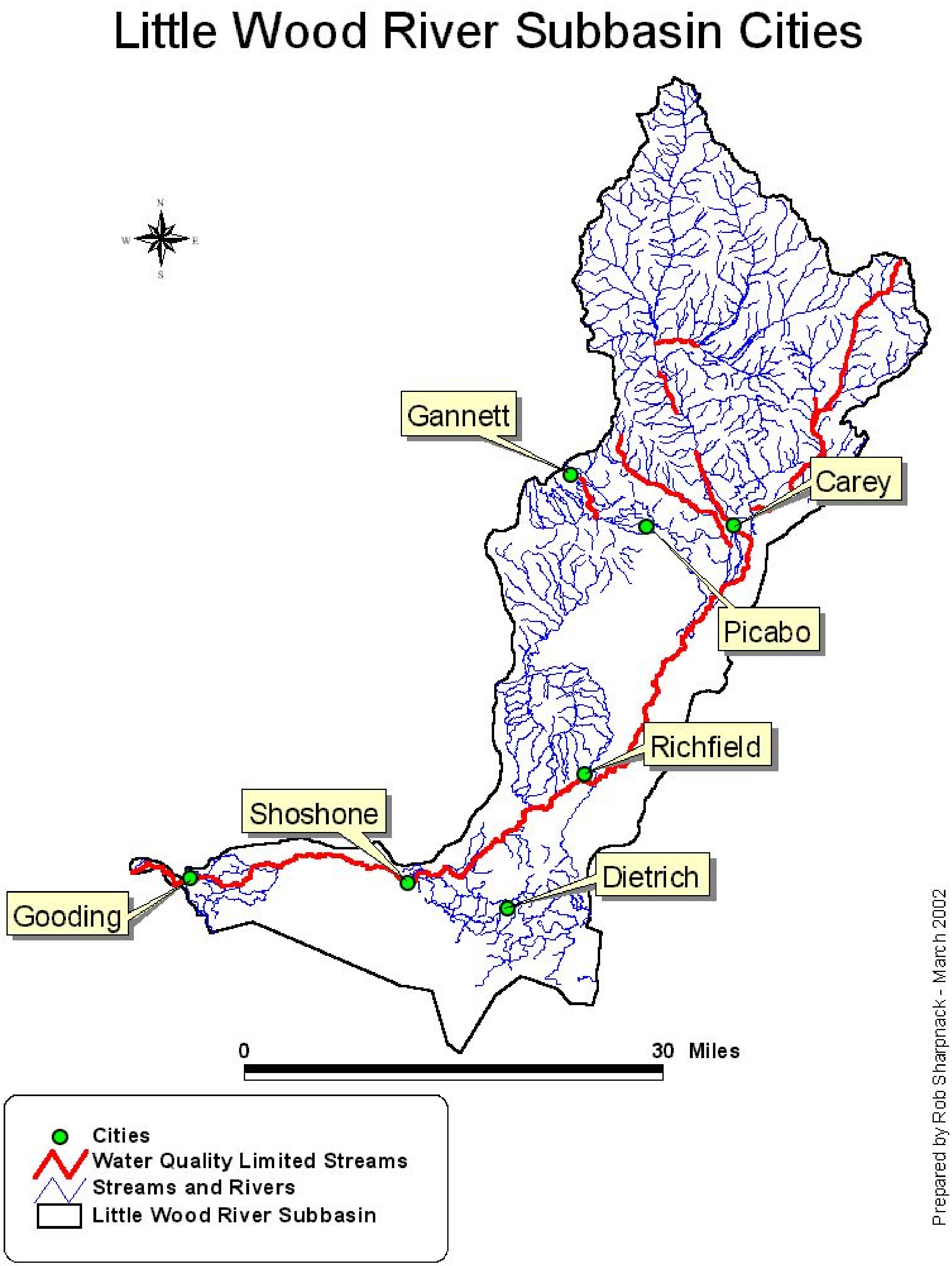

Figure 14. Little Wood River Subbasin cities.

History and Economics

The Little Wood River Subbasin is predominately an agriculture/rangeland based region, with emphasis in trade, government, and recreation. There are a number of businesses or agencies within the cities of the subbasin that provide employment, yet much of the land is used for agriculture/rangeland. In the last 10 to 20 years, there has been a great change in farming, with a general increase in the number of cattle overall. Table 13 provides a summary of the agriculture statistics of the counties of the Little Wood River Subbasin.

Table 13. Agricultural statistics in the Little Wood River Subbasin.

Year	Total number of Farms	Total Acres Farms	Average farm size (acres)	Total farms in crops	Total acres in crops	Cattle and calves in inventory	Number of irrigated farms	Number of irrigated acres
Blaine County								
1987	221	246,774	1,117	193	75,191	27,474	173	54,441
1992	221	266,293	1,205	182	75,250	29,527	179	64,283
1997	195	214,985	1,102	163	70,233	26,849	160	56,909
Percent change	-11.8	-12.9	-1.3	-15.5	-6.6	-2.3	-7.5	4.5
Lincoln County								
1987	338	145,251	430	295	90,977	32,361	283	64,764
1992	302	132,429	439	278	---	27,535	257	59,694
1997	281	131,473	468	254	---	36,422	255	72,518
Percent change	-16.9	-9.5	8.8	-13.9	---	11.6	9.9	12
Gooding County								
1987	729	239,328	328	644	128,133	83,961	621	107,793
1992	683	227,114	333	585	139,225	113,347	581	115,398
1997	675	220,362	326	529	---	140,974	542	112,665
Percent change	-7.4	-7.9	-0.6	-17.9	8.7	67.9	-12.7	4.5
Jerome County								
1987	909	205,315	226	789	161,672	68,880	768	135,272
1992	815	207,552	255	705	165,898	89,656	695	150,444
1997	683	193,921	284	570	159,852	133,648	582	151,726
Percent change	-24.9	-5.5	25.7	-27.8	-1.1	94	-24.2	12.2

[a]Data obtained from Idaho Department of Commerce Web site (2001).

The Little Wood River Subbasin has seven point source facilities (Table 14 and Figure 15). Four of these facilities are city municipalities, while the others are trout culturing, food processing or industrial facilities.

Table 14. Point source facilities of the Little Wood River Subbasin.

Facility	NPDES ID	Type	Design flow (mgd)	Existing flow (mgd)	Land application	Discharge period
Carey	ID-002574-7	wastewater	0.10	0.03	May-Aug	Sept-Apr
Richfield	ID-002121-1	wastewater	0.06	0.02	May 1-Oct 31	Nov 1 – Apr 30
Shoshone	ID-022372-8	wastewater	0.20	0.09	---	Year round
Gooding	ID-002002-8	wastewater	1.0	0.18-0.32	Summer months	Year round
Glanbia Gooding	ID-002712-0	food processing	---	0.18	---	Year round
Glanbia Richfield	---	food processing	---	---	---	---
Hayspur hatchery	---	trout culturing	---	---	---	---
Idaho Tire Recovery	---	industrial	---	---	---	---

[a]Data from DEQ NPDES files (2004).
[b]NPDES – National Pollutant Discharge Elimination System, NA – Not applicable (not NPDES permitted)

The City of Carey began discharging effluent into a tributary canal to the Little Wood River in 1986. The facility treats domestic sewage from local residents and commercial establishments, and it used to treat industrial waste from the Kraft Cheese Factory, which shut down in 1991. Waste stabilization ponds are the principal process used, and there is no discharge during the growing season from May 1-August 31. At this time, the waste is land applied. Sewage treatment in this area was previously through individual septic tanks and drain fields. Kraft Cheese was bought out by Wards Cheese in 1987 and then by Avonmore West, Inc. in 1991. Avonmore West applied for an NPDES permit to discharge non-contact cooling water, but the facility closed down shortly thereafter.

The City of Gooding wastewater treatment facility discharges their effluent into the Little Wood River, but also land applies it during the summer months. *However in the last couple of years the facility has been discharging year round.* This facility treats domestic sewage from local residents and commercial establishments. The design flow is for 1 MGD and they average a monthly discharge ranging from 0.18 to 0.32 MGD.

The City of Shoshone wastewater treatment facility discharges their effluent into the Little Wood River at river mile 21. It has a 3 cell lagoon with chlorination, which treats domestic sewage from local residents and commercial establishments. There are no industrial discharges that enter the facility. The design flow is for 0.31 cfs, which is 1.5% of the minimum stream flow of the Little Wood River (20 cfs). This facility began operating in July of 1972. The City of Shoshone land applies the waste when they clean out the lagoons.

The City of Richfield's first NPDES permit was issued November 18, 1974. It allows a two cell aerated lagoon with chlorination to discharge to the Little Wood River. The facility serves a population of 200 with no industrial discharge into the system. This facility discharges during the non growing season.

Glanbia in Richfield, also known historically as Ward's Cheese, Inc. and Avonmore West, at one time, discharged its non contact cooling water through 500 feet of ditch into the Little Wood River. Previously the non-contact cooling water was discharged into their lagoon to be land applied. When the lagoon began to overflow, an NPDES permit for the non-contact cooling water was sought. *However, at this time this facility no longer discharges to the river (Pettinger 2004).*

Glanbia in Gooding, a food processing facility located east of Gooding, has recently received a NPDES permit allowing it to discharge non contact cooling water to the Little Wood River. At this time the facility has yet to discharge its non-contact cooling water to the river. Data indicates that the TP levels in their well source are elevated periodically; therefore they may be discharging TP into the river although the facility is not contributing TP to their non-contact cooling water.

Idaho Fish and Game's Hayspur Hatchery, located south of Gannet, discharges into Loving Creek, a tributary to Silver Creek, which is a tributary to the Little Wood River. The NPDES permit for this trout culturing facility became effective on May 1, 1975. In 2001, biomass produced in this facility is 18,000 lbs of fish and 70,000 to 80,000 lbs of feed per year. These numbers allow the facility to not need a NPDES permit, and as a result are classified as a nonpoint source (DEQ 2004).

A letter written in 2001 clarifies further the status of the hatchery as a non point source. "…the hatchery is maintained at approximately 18,000 pounds of fish and feed between 70,000 to 80,000 pounds of feed per year (which is equivalent to less than 7,000 pounds per month). At this low level of production, the Idaho Department of Fish and Game is not required to have a permit from EPA to discharge to the receiving water, and the Hayspur Fish Hatchery is considered a "nonpoint source" of pollution rather than a point source (per regulations 40 CFR 122.24). I hereby notify that the Hayspur Fish Hatchery is no longer authorized to discharge under the previously, administered extended permit and you do not qualify for coverage under the new general NPDES permit. Please be advised that if Idaho Department of Fish and Game wishes to increase production in the future at this facility to more than 20,000 pounds of fish per year, and feed more than 5,000 pounds of feed in any given month, it will be considered a point source and the agency will need to acquire a waste load allocation from IDEQ and a discharge permit from EPA." (EPA 2001)

The Idaho Tire Recovery is a potential point source in the subbasin; however it does not discharge at this time; therefore it does not have a NPDES permit.

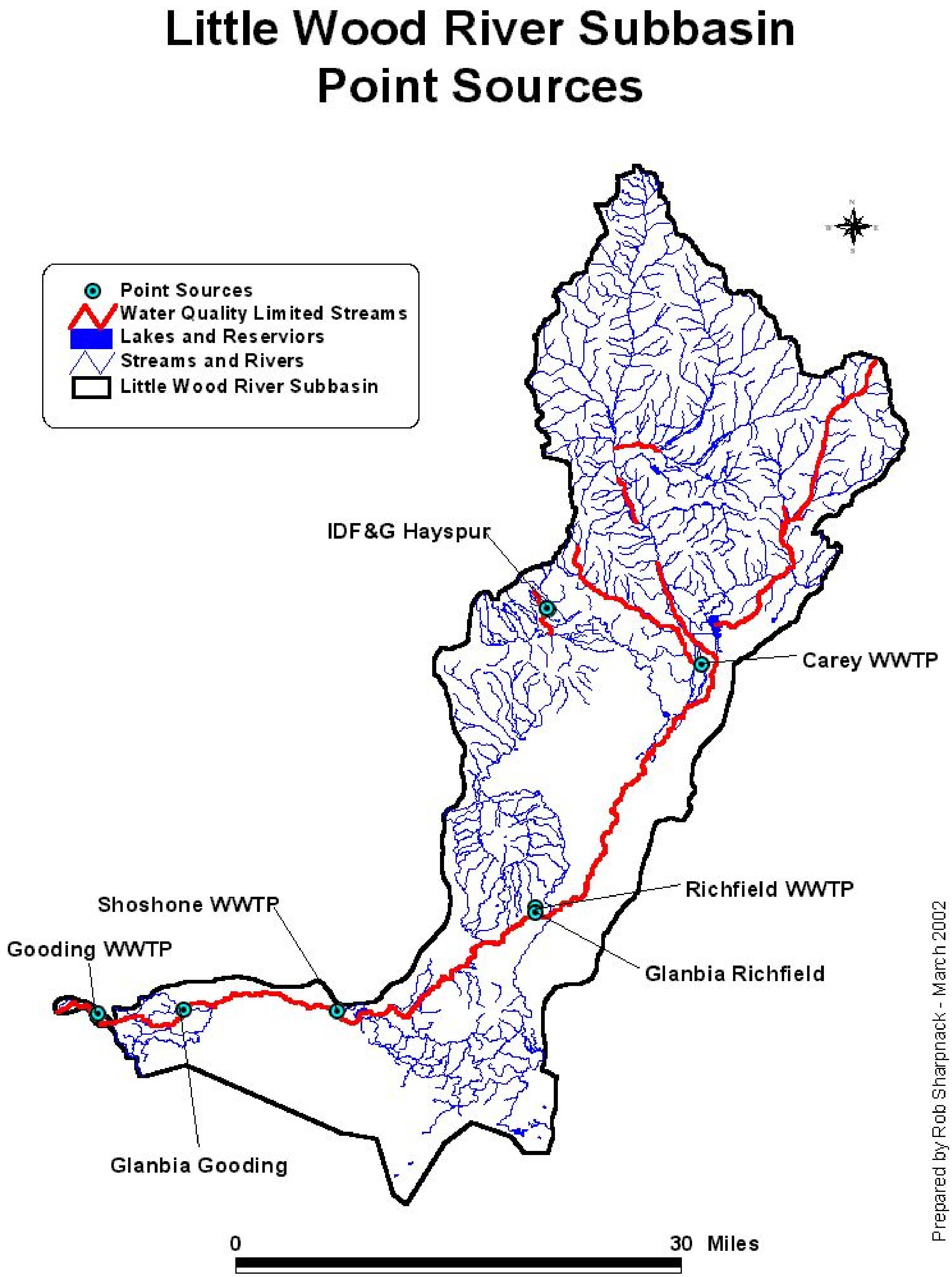

Figure 15. Little Wood River Subbasin point sources.